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ABSTRACT

This paper presents the results of a study that both quantitatively and qualitatively studied the relationship between the duration of a science education practicum and elementary education majors' self-efficacy beliefs related to science teaching. Subjects included 64 preservice elementary education majors. A notable qualitative difference was found in the experience of the practicum students who had previously taken science methods as compared to the students who had not taken science methods or who were concurrently enrolled in the science methods course. (Contains 26 references.) (WRM)

How Much is Enough? Preparing Elementary Science Teachers through Science Practicums

by

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HOW MUCH IS ENOUGH? PREPARING ELEMENTARY SCIENCE TEACHERS THROUGH SCIENCE PRACTICUMS

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Science education and the preparation of science teachers have been of great concern over the past two decades (AAAS, 1993, 1989; NRC, 1996;). The professional literature clearly notes a lack of science preparation and literacy for elementary teachers being prepared by universities. (Fort, 1993; NRC, 1996; Tobias, 1992 & 1990). In an early study Weiss (1978) found that only 28% of elementary teachers felt qualified to teach science and that on the average 90 minutes per day were spent on reading instruction versus an average of 17 minutes on science instruction. These results have been corroborated by Stefanich and Kelsey (1989) who found that less time is spent on science instruction in elementary schools than any other subject. Of the time spent on science instruction, an earlier study found that 90% of the teachers relied on textbooks for about 90% of their science instruction (Stake & Easley, 1978). Yager and Lutz (1994) found similar results and further explained that science instruction was comprised of students listening to lectures, reading from textbooks, memorizing, repeating and confirming scientific facts. Although the shortcomings of teachers and teacher preparation programs are well documented, strategies of preparation related to the practice of becoming an elementary science teacher, specifically the practicum experience, has not been well documented.

Some examples of practicums have been briefly discussed in the literature. Mason (1989) explained a teaming situation of a scientist, science educator, science teacher, and a student teacher in a practicum situation. Bagheri and Hoosho (1991) explained about an integrated practicum for science and math with the accompanying benefits of combining theory and practice. Although these references deal with practicum situations, neither focus on the length of the experience. Only one citation was found that dealt with length as the primary issue of the research which was done in an elementary social studies practicum where an eight week

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placement was compared to a sixteen week placement (Carter, 1989). No direct literature has been found to date recording how much practicum or how little practicum is enough to produce a competent elementary science teacher. In fact, in the article entitled *The Purpose, Value and Structure of the Practicum in Higher Education; A Literature Review*, Ryan, Toohey, and Hughes (1996) stated that "So little quality research has been undertaken on the effect of the length, structure and placement of the practicum that no clear recommendations can be made with confidence" (p.370). Ryan et. al additionally state that satisfaction surveys have been the most common method for evaluation in practicum courses. They suggest that more specialized surveys be given to look at specific skills and developments gained during the practicum in addition to more longitudinal studies.

Various research projects have investigated science selfefficacy beliefs from preservice through veteran teachers' service. Most report very positive experiences by students in practicum experiences, however, few reports search out whether a prime time exists for enhancing science selfefficacy throughout a preservice teacher's preparation. This in-depth study explored both quantitatively and qualitatively specific lengths of three different practicums over three years and the progression of teacher self-efficacy of preservice elementary education majors in each of the science practicum durations.

Year one of this study explored a two hour only practicum experience where a single science lesson was taught in an elementary school setting (Cannon, 1997). Year two of the study explored an "extended practicum" defined as a 12 week long course comprising 12 hours per week (totaling 144 total teaching hours). Although the practicum students were assigned primarily to teach science, other subjects were taught as well in this elementary setting (Crowther & Cannon, 1998). Year three, explored and compared the prior years of research to an elementary science teaching practicum which lasted for 15 weeks, but only 3 hours of contact time per week (Wednesday afternoons) for a total of 45 hours of practicum experience.

Methodology

Quantitative Research Design - Year One

Subjects

Subjects included 64 preservice elementary education majors. 46 students were from a large Midwestern university (41 females and 5 males) and 18 (14 females and 4 males) were from a land grant university in the west. The subjects' level of academic preparation varied by institution.

The students from the Midwestern university were in their final semester before student teaching and were enrolled in a 3-semester credit elementary science methods class that required a single, one-time only science teaching practicum experience. The students from the western university were enrolled in a 3-semester credit Supervised Elementary Education Practicum course open to juniors, seniors, and graduate students. The teacher preparation program of the western university included Masters degree, first time licensure graduate students in the practicum course. None of the preservice teachers taking the practicum course were concurrently enrolled in an elementary science methods course. Both groups of students were determined as being from the same population (elementary education majors) based upon the lack of statistically significant differences of their Preprofessional Skills Tests scores in reading($t = -1.78, p = .10$), writing($t = 9.36, p = .92$), and mathematics($t = -1.63, p = .11$).

Instrumentation

The STEBI B (Enochs & Riggs, 1990), which is the preservice version, was administered to both groups of preservice elementary teachers. The STEBI B includes 23 Likert-scaled statements relating to personal beliefs about teaching science. Response categories are "strongly agree", "agree", "uncertain", "disagree", and "strongly disagree." The STEBI B measures two sub-scales inhering to Bandura's (1977) theory of self-efficacy and applied to teaching by Gibson and Dembo (1984). The two subscales are personal science teaching efficacy beliefs (PSTEB) and science teaching outcome expectancy (STOE). The sub-scale for PSTEB numbers 13 statements. A full account of the reliability and validity measures for STEBI B can be found in

Enochs and Riggs (1990). This study resulted in a Cronbach's alpha of .83 for the PSTEB and .77 for the STOE.

The administration of the STEBI B occurred at roughly the same time for both groups. The Midwestern completed the STEBI B after teaching one science lesson in a public school. This lesson was taught near the end of the university semester. The lessons lasted approximately 1 and a half to 2 hours in length.

The western preservice teachers completed the STEBI B after an extended practicum experience in a local public school. The practicum experience ran from 8:00 a.m. to 12:00 noon on Tuesdays, Wednesdays and Thursdays, for 12 weeks, totaling 144 hours of pupil contact time. Although the primary responsibility of the preservice elementary students in the practicum was to teach science lessons from the adopted public school science curriculum, they also were responsible for daily management routines and any other planned content area lessons with the permission of the cooperating classroom teacher.

Analysis

A modified quasi-experimental pretest-posttest design with nonequivalent groups was used in this research. PSTEB data obtained from the Midwestern university was compared to PSTEB data collected from the western university. The independent variable was the different university preservice elementary teacher groups (Midwestern and Western). The dependent variable was the PSTEB scores from the STEBI B for both groups. The experimental group was the western university's preservice teachers. The experimental treatment was the length of the practicum experiences (12 week long practicum experience as compared to a single 1 and a half to 2 hour practicum experience). The control group was the Midwestern university preservice elementary teachers.

Due to the small sample size and ordinal nature of the STEBI B data, nonparametric analyses were deemed appropriate. Mann-Whitney U tests were performed on both pre and posttest PSTEB scores from both university's preservice teachers. Results of these analyses can be seen in Table 1. No qualitative data were taken during year one.

Table 1
PSTEB Pretest Scores of Midwestern and Western University Preservice Teachers before a
Practicum Experience

Group	N	Sum of the Ranks	Z	p
Midwestern*	46	533.5	.38	.70
Western**	18			

* median PSTEB score = 54

** median PSTEB score = 56

Quantitative Research Design - Year Two

Subjects

Subjects included 19 preservice elementary education majors (17 females, 2 males) enrolled in a practicum experience in a local elementary school. The students were enrolled in a 3-semester credit Supervised Elementary Education Practicum course open to juniors, seniors, and graduate students during the spring 1997 semester. The practicum experience ran from 8:00 a.m. to 12:00 noon on Tuesdays, Wednesdays and Thursdays, for 12 weeks, totaling 144 hours of pupil contact time. Although the primary responsibility of the preservice elementary students in the practicum was to teach science lessons from the adopted public school science curriculum, they also were responsible for daily management routines and any other planned content area lessons with the permission of the cooperating classroom teacher.

In addition, the practicum students were responsible for leading and presenting a science festival at the school. While science festivals resemble science fairs, this festival differed in that only whole class, or group projects were presented. No formal judging took place, and each child received a special certificate and was recognized for some contribution to the project, (i.e., best lettering, best construction, etc.) at a science festival assembly held at the school after the festival.

A form of the time-series design called an *equivalent time-samples design* was used in this study. Tuckman (1972) writes, "... the equivalent time-samples design is used when only a single group is available for study and the group's pattern of experience with the treatment is

highly predetermined -- that is, the researcher must expose the group to the treatment on some systematic basis" (p. 116). The manipulated variable, or treatment, in this study was the practicum experience and teaching children science lessons on a daily basis. The responding variables were the practicum students' scores on the Science Teaching Efficacy Beliefs Instrument (STEBI-B) by Enochs and Riggs (1990) and the Science LOCus of Control I and II (SciLOC I and II) by Haury, (1988).

Clearly, test sensitivity was a major threat to internal validity. In an attempt to lessen this threat, the SciLOC I and SciLOC II instruments were administered during weeks 8 and 9. The 18-item SciLOC questionnaires measure a participant's LOCus of control (LOC), or belief about the internal or external responsibility for learning, in relation to science education. Reliability measures for SciLOC I and II were established by internal consistency coefficients of .73 and .75 respectively (Cronbach's Alpha) (Haury, 1988). Haury (1988) states, "An assumed benefit of increased internality is increased success as a teacher" (p. 234). A positive correlation was found to exist between the SciLOC I and STEBI B questionnaires ($r = .43$; $p < .01$) supporting the speculation that both measure similar constructs (Cannon, 1992). Therefore, the SciLOC I and II instruments were deemed appropriate as additional data collection instruments for perhaps revealing an additional facet of relationship between the STEBI B and SciLOC instruments.

Qualitative Research Design - Year Two

The qualitative parameters of this study included pre and post interviews, supervisor and cooperating teacher observation notes, and student journal analysis. For the qualitative part of this study 6 students were purposefully selected and studied in-depth in a multiple case study design (Merriam, 1988) (See Table 2). For further investigation of the differences in the PSTEB quantitative analysis, two students were selected who had taken the elementary science methods course before the elementary science practicum course, two students were selected who were concurrently enrolled in the elementary science methods course and the elementary science practicum course, and two students who had not previously taken nor was concurrently enrolled in the elementary science methods course. This information was then compared to the

qualitative part of the Crowther and Cannon (1998) study for further comparison of the data. Some very interesting themes emerged with wonderful dialogue and anecdotal data.

Table 2
Selected Participants and Science Methods / Practicum Status

<u>Participant</u>	<u>Methods / practicum status</u>
001	Concurrently enrolled in science methods and practicum
002	Previously completed science methods before taking practicum
003	No previous or concurrent science methods to practicum
004	Previously completed science methods before taking practicum
005	Concurrently enrolled in science methods and practicum
006	<u>No previous or concurrent science methods to practicum</u>

Quantitative Research Design - Year Three

Subjects

Subjects included forty-nine preservice elementary education majors (45 female, 4 male) enrolled in a practicum experience in one of three local elementary schools. The students were enrolled in a 3-semester credit Science Practicum in the Elementary School course open to juniors, seniors, and graduate students during the spring 1998 semester. The practicum experience ran from 1:00 p.m. to 4:00 p.m. on Wednesdays for 15 weeks, totaling 45 hours of pupil contact time. Although the primary responsibility of the preservice elementary students in the practicum was to teach science lessons from the adopted public school science curriculum, they also were responsible for daily management routines and any other planned content area lessons with the permission of the cooperating classroom teacher.

These practicum students, as also in year 2, were responsible for leading and presenting a science festival at the school.

Instrumentation

The STEBI-B was used again for data collection in year 3 of the study. Due to the reduced number of times the STEBI B would be administered during the semester (3 in total: pre,

middle, and post practicum experience), test sensitivity was deemed a lesser threat than in year 2, and consequently, no similar instrument was administered (e.g., SciLOC).

Qualitative Research Design -- Year Three

The qualitative parameters of this study included pre and post interviews, survey questions, supervisor and cooperating teacher observation notes, and student journal analysis. For the qualitative part of this study 22 students were purposefully selected and studied in-depth in a multiple case study design (Merriam, 1988). The purpose of the qualitative study was to explore efficacy progression in the practicum experience. Thick and rich descriptions were developed from the participants which helped define the statistical analysis.

Results

Quantitative Results - Year One

No differences were found to exist in PSTEB pretest scores (pre-practicum experience) between the Midwestern and western preservice teachers as seen in Table 1. Therefore, both groups were considered to be equivalent in efficacy beliefs.

Table 3 reveals a statistical difference in PSTEB posttest scores (post-practicum) between practicum experiences (one-shot 2 hour experience vs. 144 hours of classroom teaching). Effect size was calculated to be .57 (reject practical significance if $< .33$) (Borg, Gall & Gall, 1993).

Table 3
PSTEB posttest scores of Midwestern and Western University Preservice Teachers after a Practicum Experience

Group	N	Sum of the Ranks	Z	p
Midwestern*	46	1363.5	-1.96	.04
Western**	18			

* denotes group with a single, one time only practica experience 1 and a half to 2 hours in length; median score = 56

** denotes group with a 144 hour requirement of elementary science teaching practica experiences; median score = 60

A corollary facet of the data analysis of the PSTEB posttest scores revealed no significant difference in variance. This result suggests that previous enrollment in an elementary methods course has little influence on preservice teacher's personal science teaching efficacy beliefs (see Table 4).

Table 4
Analysis of Variance of PSTEB Posttest Scores of the Western University Preservice Teachers
(Methods vs. Non-methods students)

Source	DF	Sum-Squares	Mean Square	F-Ratio	Prob>F	Error
A (METHODS)	1	40.5	40.5	2.74	0.1173	ERROR
ERROR	16	236.44	14.78			
TOTAL(Adj)	17	276.9445				

Quantitative Results -- Year Two

Descriptive results of the STEBI B and SciLOC administrations can be found in Tables 5 and 6. Figures 1 and 2 show the line plots of the STEBI B subscale scores.

[Due to space limitations, see Figures 1 and 2 in the online paper at http://www.ed.pse.edu/CI/Journals/1998AETS/s3_2_crowther.rtf]

Figure 1. Line plot of Personal Science Teaching Efficacy Beliefs Scores (PSTEB) scores for weeks 1 - 7, and 10 - 11.

Figure 2. Figure 1. Line plot of Science Teaching Outcome Expectancy Scores (STOE) scores for weeks 1 - 7, and 10 - 12.

Table 5
Descriptive statistics of STEBI B scores for Practicum Weeks 1 - 7, and
Weeks 10 - 11.

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
EFFWK1	19	50.89	6.28	1.44	40	62	967
OUTWK1	19	40.11	5.31	1.22	32	50	762
EFFWK2	19	51.84	6.26	1.44	40	64	985
OUTWK2	19	40.89	4.72	1.08	34	50	777
EFFWK3	19	53.53	5.44	1.25	42	65	1017
OUTWK3	19	40.21	4.30	.99	35	50	764
EFFWK4	19	53.53	5.44	1.25	42	65	1017
OUTWK4	19	40.21	4.30	.99	35	50	764
EFFWK5	19	57.68	5.16	1.18	46	64	1096
OUTWK5	19	41.68	4.57	1.05	33	49	792
EFFWK6	19	55.05	4.70	1.08	44	64	1046
OUTWK6	19	41.58	4.74	1.09	35	50	790
EFFWK7	19	54.84	4.68	1.07	46	63	1042
OUTWK7	19	40.47	6.16	1.41	26	50	769
EFFWK10	19	59.74	4.21	.97	53	65	1135
OUTWK10	19	42.11	4.62	1.06	34	50	800
EFFWK11	19	59.89	4.07	.93	52	65	1138
OUTWK11	19	42.21	5.74	1.32	33	50	802

EFF = Personal Science Teaching Efficacy Beliefs Scores (PSTEB)

OUT = Science Teaching Outcome Expectancy Scores (STOE)

Table 6
Descriptive statistics of SciLOC I and II scores for practicum weeks 8 & 9

	N	MEAN	STD	SEM	MIN	MAX	SUM
Week 8 LOC	19	25.632	2.608	.598	21	31	487
Week 9 LOC2D	19	49.000	3.697	.848	44	57	931

Table 7 reveals a statistically significant difference in PSTEB scores between weeks 1 and 12. Table 8 displays a similar statistically significant difference in STOE scores between weeks 1 and 12.

Table 7

Wilcoxon's signed rank test results between PSTEB scores from week 1 vs. week 12

Sum of the positive ranks = 0.
Sum of the negative ranks = 190.
Number of samples = 19
Using Wilcoxon table lookup, $p \leq 0.005$ (one tail)

Table 8

Wilcoxon's signed rank test results between STOE scores from week 1 vs. week 12

Sum of the positive ranks = 32.5
Sum of the negative ranks = 103.5
Number of samples = 16
Using Wilcoxon table lookup, $p = .037$ (one-tailed)

Quantitative Results -- Year Three

Data were similarly analyzed in the third year of the study as in previous years. Pre and post gains in PSTEB scores were investigated. Due to the nature of this longitudinal study, effect sizes became more important in determining if an *ideal* length of practicum experiences for preservice elementary science teachers did exist. Results of year three can be seen in Tables 10 and 11.

Table 9
 PSTEB Posttest scores of Elementary Preservice Teachers during a 15 week,
 45 hour science practicum experience

Variable	Count	Mean	Std. Deviation	Minimum	Maximum
School 1	8	54.85714	3.48466	51	61
School 2	18	54.375	4.529533	47	65
School 3	22	59.0625	3.872445	52	65

Table 10
 Analysis of Variance of PSTEB Posttest Scores of Elementary Preservice Teachers during a 15
 week, 45 hour Science Practicum Experience

Source	DF	Sum-Squares	Mean Square	F-Ratio	Prob>F	Error Term
A (...)	2	195.6861	97.84306	5.82	0.0065	ERROR
ERROR	36	605.5446	16.82068			
TOTAL(Adj)	38	801.2308				

Scheffe's Procedure

Factor(A): ... Error: ERROR

Summary Results alpha = .05 Level Codes

Code(Level)	Mean	ABC
A(School 1)	54.375	. . S
B(School 2)	54.85714	. . .
C(School 3)	59.0625	S . .

Note: An "S" in the above table represents a statistically significant difference between groups at the .05 level

Table 11
 Effect sizes of length of practicum experiences (in hours) -- Years 1-3
 PSTEB scores

Year	Time Length	N	Pre	Post	SD	Effect Size
One	1.5-2	64	52.76	55.28	4.74	.57
Two	144	19	50.89	59.89	6.28	1.43
Three	45	60				
	School 1		48.55	54.85	6.61	.95
	School 2		51.57	54.37	4.40	.63
	School 3		53.95	59.06	4.20	1.32

Schools 1 and 2 were new schools added to the practicum experience and the longitudinal study during year three. School 3 was involved in the study for all three years. While only speculation, the effect size for School 3 might be higher than Schools 1 and 2 due to the fact that it has been in the study the longest and that the practicum teachers at School 3 were very well versed on the purpose and method of the practicum experience. Consequently, there was far less of a learning curve in School 3 than Schools 1 and 2.

Qualitative Analysis

Due to the excessive length of year two qualitative analysis, only year three will be presented here. There were no qualitative data taken for year one. Please see Crowther and Cannon (1998) for the full explanation.

Qualitative Results --Year Three

Elementary science methods or science practicum - Which should come first. . . (a validation from year two)

Qualitative results from year two of this study were interesting in the fact that we compared the effect of a formal methods experience taken before the science practicum, concurrently enrolled in science methods and science practicum, and having no methods experience before taking the science practicum. (See qualitative results section - year two) The students who had previously taken a formal methods course in science had more in-depth answers to the questions and seemed to get more out of the science practicum. The year three study only admitted students into the science practicum who had taken a formal science methods course prior to the practicum experience.

This thinking was validated by all of the students enrolled in the practicum. In the final interview at the end of the semester, several of the responses from the practicum students in the year three study included the following comments.

Kara stated specifically that, "The methods class was fun, interesting and exciting, but having this chance to now turn these around and implement these techniques into a class of my very own was very easy."

Nakonia stated, I think that the most important thing that I have learned this semester is how to teach science. By taking the Methods course and then the practicum, it has opened more avenues for me. Now I was able to implement what I learned from my methods course, I can see why hands-on is so big. I found that teaching hands-on science is the only way to go. I really feel that by having the students do an activity, it actively engages them and makes them think and come up with their own theories. When I taught I used the 5E format. I believe that by using this format, it helps you as the teacher interact more with the children.

Jessica mentioned that,

"My favorite episode with this practicum class was on the very last day. I taught the *Yeasty Beastie* lab. The kids loved crushing the cereal and then observing the (zip lock) bags inflate as a result of the gas (carbon dioxide) created by the yeast. I think that this lab went so well is because I had actually done this lab in the methods class and I knew how the children were going to respond. The management went really well and I think that a part of that was because I had seen it done before.

From the instructor point of view, it was also an easier experience in that all of the students knew how to write lesson plans in the Learning Cycle format and knew the expectations of teaching inquiry / discovery hands-on science because they had previously experience a semester where that was the primary focus. We can conclude from the third year of practicum experience, where all practicum students were required to take science methods previously to the practicum course, that having the methods first cut down on many problems such as understanding lesson planning, hands-on teaching methodologies, and general understandings of developmentally appropriate science lessons. All of which were problems previously encountered by students who had not taken methods prior to practicum in previous years.

Efficacy - Does 100 hours in the classroom make a difference?

What is Efficacy

Bandura (1981) showed that people's beliefs in their own abilities had an effect on their performance. He found that behaviors occur when, a) people believe in their own ability to perform that behavior and b) people expect, based upon their own life experiences, that this behavior will result in a desirable outcome. The first belief, in which people believe in their own ability, Bandura called self-efficacy (Schoon & Boone, 1996). The second belief is closely connected to the confidence that one develops based upon their efficacy.

In year two of this study all of the participants had great gains in efficacy in teaching science. None of the students felt that they had spent too much time in the classroom and many felt that spending 144 hours for a practicum was sufficient enough to learn how to teach science. So, how would students respond after a 45 hour practicum? The quantitative data showed that self efficacy scores on the STEBI B were high in both practicums and that in the 144 hour practicum the effect size was half again as large as the effect size of the 45 hour practicum.

However, the qualitative responses seem to be just as strong. During the 15 week (45 hour) practicum the students responded to their experiences in a weekly journal. The journal format that was used was the Posner (1993) format which uses a logical formula by which the journaling assignments were based upon: $(E + R = PG)$ "experience plus reflection equals personal growth." As part of the class stipulations, each student was required to keep a reflective journal of the activities, and events of the practicum in a two way dialogue format. Each week the journal entries were read and responded to by the instructor. Each time the journals were read they were evaluated by the researcher on a scale developed to determine efficacious statements (See Table 11).

Table 11
Three Point Journal Rating Scale

Reflection Rating	Explanation of Rating	Examples:
1	No efficacious statements	Facts only "Today I taught bubbles. It took 35 minutes. Next we discussed . . ."
3	Efficacious statements non specific or alluded to:	"The kids really got into the lesson today which made me feel good."
5	Specific efficacious statements	Specific words used in reflection - such as confidence, enjoyment, ability, etc. "I am really feeling confident in my teaching ability."

During the first two weeks of the practicum course the majority of the reflections were rated as primarily 1 and 3. However, beginning with the third week, only one 1 and five 3's were given with the rest of the responses being 5's. This pattern continued throughout the semester. Not surprisingly, the last three entries recorded all 5's.

At the end of the practicum in exit interviews of the experience, all of the participants in the year three study discussed how much more confident they were to teach science now that the practicum was over. A representation of responses from each grade level is shared below.

"I can do this . . ."

Alisha had the opportunity to teach in the first grade. Many students think that teaching in the first grade would be easy. After the first week they realize that teaching must be adapted and that age appropriate lessons are a lot of work. Her cooperating teacher was also exceptional in that she taught in a very integrated manner. Alisha was a natural and adapted fast to the situation. She explained her experience in first grade with new appreciation.

I feel that this practicum has helped me believe more in myself that I can do things that I never thought were possible. I never realized how much hands-on exploration of science I could offer to a group of children. Now when I have my own classroom, I will be able to integrate that lesson with science math and social studies.

I feel that the single most important thing that I learned this semester is to be flexible. I realized as I got going what I could offer to the kids about science in ways that I never thought were possible. This is the greatest thing that I have learned. . . That learning is all around us in places and things you never thought about. It just takes a little more thought to figure it all out.

Erin had an unusual practicum experience. She was placed in a second grade classroom with 33 children. She had two cooperating teachers in a team teaching situation. The thing that made Erin's experience different was that she did whole group instruction by herself and learned management skills in a big hurry, especially for the quiet and shy personality that she began with. After her experience was over Erin perhaps had more of a real understanding of crowd control, but the fact that she was successful showed that she really was a good teacher.

Erin was brief, but concise.

"I feel that this practicum was the best one that I have had. I feel more confident in my abilities as a teacher due to the experiences that I had in this practicum. When I first entered this classroom I was very nervous about being in front of thirty-three students and two experienced teachers. I feel that I have gained the experience needed where I can walk into any classroom and not worry."

Deanna was in a third grade classroom. She began this experience with some hesitation, as everyone did, but the progress that she shared at the end of the experience was particularly insightful. Deanna explained:

"I have always known that I wanted to be a teacher. It wasn't until this semester that I allowed myself to say, "I am good at what I do." I truly believe I am a good teacher. I realize that I still have a lot to learn, but I am confident in my ability to do my job well.

This semester brought all of my past education together. In this past semester I was able to actually get into the classroom and use what I had learned on my own. I was responsible for the class's learning. I felt like I was actually treated as a teacher this semester; this allowed me to fully realize my potential to be a great teacher.

I think that the single most important thing that I learned from CI 365 is that no matter how daunting a task may seem, it is always possible. When I began planning my science lesson on the solar system I actually thought "How on Earth do I make the solar system fun and hands-on." When I remembered that I thought I just had to laugh, because I realize now that my fear should have been "How on Earth do I ever choose from all of the fun and hands-on activities I can do with the solar system?" I learned that if a person is dedicated they can turn anything into a fun and hands-on activity for students, it just takes some concentration and determination."

Terri is a dual (Special and Elementary Education) major. Therefore her assignment was in a self contained special needs third grade classroom. She did not consider herself great in science, but did have an interest in science as it applies to real life, especially as it applies to skiing as she is an avid skier and currently works in a ski shop.

Terri spoke of her experience:

"I was always amazed on what the students actually learned. I never knew I could teach so all the students could participate and learn. It was interesting because at the beginning of the semester, my planning of the lessons took at least 2-3 hours to generate a lesson. By the time I was done with the practicum, my lesson planning began to shorten to 1-2 hours! It seemed as if it was getting easier."

Kate is not new to the education world. Kate's mom is an elementary teacher and so she grew up with the experiences of "living in the classroom." Kate mentioned that she always knew she was going to be a teacher and would even play school at a young age where she would invite friends over and she would write on the chalkboard for them.

Kate taught in a fourth grade classroom and spoke of her experience:

"I feel that my potential for becoming a teacher keeps growing with each class that I take. I've always spent time in classrooms, not just as a student, but as an observer, since my mom's still teaching. However, I never really understood just what it took to get the day's lessons ready and make the work. I believe that I will just keep getting better, I certainly feel

confident enough as I embark on my student teaching. I feel really confident in my abilities as a teacher, even though I know that I still have a long way to go.

I think that the thing that I learned most from my 365 experience isn't really science related. It's that I have the ability to make such a big difference in so many lives, and that I'm good at teaching! I love it, and the kids really seem to relate to me well. They treated me with respect, but seeing their faces light up when they see me there, really made me realize that I'm doing the right thing."

Nakonia had the opportunity to teach in the fifth grade. She was very nervous before the experience began. Several weeks before the class she called and was very concerned about her ability to teach science, she was basically looking for reassurance that she could actually do this practicum. Many preservice teachers feel this way, especially in science. Nakonia prepared herself and began teaching just a few days after her honeymoon. At the end of her practicum she described her experience:

"I have never really been great at science and was nervous to teach the subject. Since the methods class focused on teaching hands-on science, I wasn't given the opportunity to go out and test these activities. With the practicum, I found it to be very beneficial. I started out very nervous and told my cooperating teacher, she was so understanding. The more I taught, the more I felt comfortable teaching science. It is a learning process and you learn as you teach. The part that I was nervous about were kids asking me science related questions that I didn't know. I don't have a strong background of science, but when a question came up and I didn't know the answer, we found out together as a class. . . . With this experience, I feel that I'm ready to teach and have enough confidence and experience to go on to student teaching."

Kara did her teaching in the sixth grade. Kara was not sure about teaching the "big kids" at first. However, after her experience was completed, she not only felt confident teaching sixth grade, but also confidence in learning and teaching fairly sophisticated science content as well.

Kara explained:

"I feel very confident for my potential to be a teacher. When I first started this education program, I was very hesitant about teaching science. I have never really been a "science geek," so for me to turn and teach the different areas of science seemed to be quite a challenge for me, before I ever even began. Well, some good news!! I have really changed my mind about teaching science, and this practicum experience influenced this change to an extreme. I think the single most important thing that I have learned from this practicum would be that I *can* teach a subject I am unfamiliar or uncomfortable with, it just takes initiative, motivation, preparation, planning, creativeness, and an open mind! I feel that I have demonstrated all of these techniques during this practicum."

All of the 22 participants that were involved in the qualitative study had similar comments as the seven examples above. As can be seen from the above samples from exit interviews, students engaged in the 45-hour practicum seem to have a strong feeling of confidence and self-efficacy towards the teaching of science and progressing on to student teaching. When the post interviews of the 45-hour practicum students were compared to the post interviews of the 144-hour practicum students, the statements sounded qualitatively the same. In fact, the year 2 study concluded that:

In response to the anxieties about teaching science, all of the participants had high anxiety in the pre interview. Responses ranged from "oh yea" to "I have taught kids before, but I am still just as nervous as I was the first time." By the end of the practicum all of the students were *very confident* in their ability to teach elementary science. All of the participants felt that the time in the classroom was just right and that very few improvements be made on the course" (Crowther & Cannon, 1998, p. 11).

We could basically write the same conclusion to the third year of the study. If the post efficacy statements were basically the same from the 144-hour and the 45-hour practicum, then

one would be forced to wonder about the extra 100 hours in the classroom. When the students in the year two study were asked about the length or time in the classroom (144 hours), "the comments from the participants strongly support that the time in the classroom was just right. In an exit interview with all (22) of the students, no one said that the time was too long and the only response of the time being too short was a participant that really liked working with the kids and would miss them (Crowther & Cannon, 1998, p. 11). At the end of year three, once again all of the 22 participants stated that the time was just right. The only participant who said the time was too short was Kate who said, "We only got to see the students once a week, which didn't give us a lot of time to build a solid relationship with them. However, I feel that we did a good job working with the students and building rapport with them regardless."

Therefore, if the result of the practicum was to build prolonged relationships with children, the 144-hour practicum would be best. If the result of a practicum was to make an efficacious teacher, then there is no qualitative difference between the 144 and the 45-hour practicum from the students' point of view in this study. However, the cooperating teachers from the school where the qualitative study was performed in year 2 and year 3 had mixed emotions.

The cooperating teachers in the school were split evenly over the length of the practicum. The teachers that favored the year 2 practicum (144-hours) said that the students were able to have more continuity with the curriculum by taking a lesson from start to finish over several days. They also mentioned that the students were better respected as a teacher because they were in the classroom more and had greater opportunities for management resulting in carrying out rewards and punishments over several days.

The teachers that favored the year 3 practicum (45 hours) spoke about the unobtrusiveness of the practicum. University students coming in once a week didn't really interrupt the daily routine as the 3-day a week practicum. These teachers also spoke of how the practicum lessons seemed better and more intense than the previous year because they had to get a lesson done in one afternoon. The teachers also mentioned the elementary students reacted well because they knew the lesson was going to be very interactive and supplement the normal

unit of study. When the faculty was asked which practicum they would prefer for the following semester, the vote was by far in the majority of the 45-hour practicum. Even though the 144-hour practicum had some great benefits, the teachers at this school seemed to prefer the less obtrusive, but intense science practicum experience.

Bandura (1981) proposed that self-efficacy could be enhanced through modeling and successful mastery experiences. Gibson and Dembo (1984) concluded from their studies on teacher beliefs and self-efficacy that "student learning can be influenced by effective teaching" (p. 48). They further concluded that teachers who also have confidence in their own teaching abilities (self-efficacy beliefs) should persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning. The participants in this study (year 2 and year 3) did make large gains in both self-confidence and self-efficacy as was postulated by Bandura (1981). However, in order to capitalize and implement the effects of the increased confidence and efficacy as proposed by Gibson and Dembo (1984), the preservice teachers needed to feel empowered in both teaching and learning situations that seemed to take place in both the 144 and 45-hour practicum.

Discussion

We believe that a sign of valuable research is when more questions are raised from a project than were originally asked. This research study did exactly that.

Based upon the review of self-efficacy research, one could safely predict that an extended practicum experience would positively influence PSTEB scores more so than a shorter practicum experience. Many have suggested that "experience is the best teacher." What is interesting about this prediction is determining when, if ever, a point of diminishing return exists in field work or practica experiences.

Year one data noted that the Midwestern university preservice teachers' mean PSTEB posttest score was 56.28 (model response = 65) as compared to the western university's mean PSTEB posttest score of 58.94 (mr = 65). A difference of roughly 3 points demonstrated

statistical variance. Effect size was calculated to be .57 (reject practical significance if $< .33$) (Borg, Gall & Gall, 1993). Borg, Gall, and Gall (1993) state that "an effect size of 1.00 is twice as large as effect size of .50. The mean of the effect sizes...can be calculated to yield an estimate of the effect of the experimental program or method..." (p. 171). Therefore, according to Borg et al. one could argue that the effect of the extended practicum was roughly twice as "effective" as the single, one time only practicum experience.

Year two's primary focus was what is the most ideal amount of practica experiences? The results of the year two data reveal that during an 12 week practicum experience, PSTEB scores continued to raise, except for weeks 5 -7, where the scores remained fairly constant. Approximately the same increase in PSTEB scores occurred during the first 4 weeks as occurred during the last 4 weeks of the study (9 points in total). While it is only speculation, the later increase in scores might be a result of the science festival presentations held at the elementary school just after mid-term of the semester. Students could have experienced enhanced self-efficacy through an additional, somewhat more exciting, science teaching experience (science festival) in conjunction with their daily classroom experiences.

Year three's focus shifted from the total number of hours required for an *ideal* practicum experience to investigating the effect size of each experience.). Borg et al. (1993) remind readers that "The mean of the effect sizes from different studies can be calculated to yield an estimate of the effect that the experimental program or method produces relative to a comparison intervention" (p. 171). While this study is not a meta-analysis in nature, it does, however, try to glean estimates from changing study parameters over a three year period.

But, yet another very important question arises. If the question raised above is reversed, could one argue for *less time* to be spent in elementary science teaching practicum experiences? It appears that 9 out of 65 total PSTEB points are gained toward "ideal" science teaching efficacy by increasing supervised practicum experience pupil contact teaching time to 144 hours. Does this result support the call for increased practicum experiences and time spent supervising such experiences by already overburdened university content area specialists? Perhaps, but we

strongly suggests that "a point of diminishing return" someday will be determined through an expanded research agenda relating to science self-efficacy and practica experiences.

Collateral Results

The inservice teachers' extracurricular experiences also had a great impact on the elementary students. The elementary school principal of the practicum school was quick to share that science has been progressively taught more in the school over the past three years. In fact, the Terra Nova standardized test scores for the fourth grade have increased from the 48th to 62nd percentile over the last two years.

The school's principal explained that the only science inservice done over the last two years was the summer professional development program that involved six teachers associated with the university practicum. There had been no changes in science other than the preservice science practicum students in the school and the professional development workshop. He concluded that the single biggest factor of the improved scores was due to the partnership between the university and his school that made the practicum possible. He said, "It is no mystery why the scores have improved. Having practicum students in the school and the excitement they continually bring to teaching science in this school has made the difference."

Conclusions

Westerback and Long (1990) investigated the impact of self-confidence and anxiety on science attitudes and science teaching. They stated, "curriculum advances have little chance of success unless the background, comfort, and approach of these [elementary] teachers can be altered and upgraded" (p. 362).

Through practicum experiences, prospective teachers get the opportunity to interact and "practice" teaching. This study found that there was a notable qualitative difference in the experience of the practicum students who had previously taken science methods as compared to the participants who had not taken science methods or who were concurrently enrolled in the science methods course.

There are some great limitations to this study. Repeating the same instrument on a weekly basis, as in year two, results in the loss of some of the integrity of the instrument. The interviews helped to clarify the answers from the STEBI B and the practicum experience, but the interviewer was a professor that most of the students had taken courses from before and liked. That could cause some interview bias. Although there is no substitute for experience, the quest for the ideal length of practicum still remains.

Finally, it must be noted that there were some interesting differences between the 3 schools included in the third year of the study. The first two schools were in their first practicum experience. The third school, which was also qualitatively studied, was in its third year of having science practicum students. The teachers were well informed and were a part of the study. They knew what was expected for the experience and made it happen for the students. Moreover, nearly 1/4 (6 of 27) of the teachers in the school had been a part of a summer inservice elementary science program over the past two summers where hands-on science along with inquiry and discovery types of teaching were modeled and practiced.

This involvement over time strongly supports Enochs and Riggs (1990) ideas that self-efficacy needs to be sustained over time for best results. It is well known that results of an innovative workshop wear off over time. By involving the cooperating teachers during the academic year in the practicum and having them work during the summer in a professional development workshop, only to go back as specialists and teach a new semester of practicum students, enabled the efficacy of both inservice and preservice teachers to remain high.

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